

This patent document describes an Fe-based alloy having a high permeability, represented by a composition formula of  $Fe_aM_bX_c$ , where M is at least one element selected from a group consisting of Nb, Zr, Ta, Hf, Ti, V and Si, X is hydrogen or oxygen, and a,b and c satisfy conditions of  $85at\% \leq a \leq 97at\%$ ,  $4at\% \leq b \leq 12at\%$ ,  $4at\% \leq c \leq 10at\%$ , and  $a+b+c=100at\%$ . The Fe-based alloy primarily is an  $\alpha$ -Fe ultramicrocrystalline phase wherein a crystal grain diameter is equal to or less than 20 nm. The Fe-based alloy exhibits a saturation flux density  $B_s$  equal to or more than 1.5 T, and a high initial permeability  $\mu_I$  (5 MHz) equal to or more than 3000.